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Impacts of Robotic Assisted Surgery on Hospital's Strategic Plan

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Abstract

Abstract: In this paper presented a methodological approach of the possible effects, considering various aspects, of incorporating robotic systems in complex environments like hospitals. In particular we examine the implementation of robot-assisted surgery systems, which are of key importance within hospital's environment. Although robotic systems are quite new and not widespread, due to various reasons, it has been identified that those systems affect seriously the whole operation of the hospital. The analysis take into account the different aspects like Surgical, Economic, Organizational, Structural as well as Legal issues, Ethical issues and Patient issues that are related to the implementation of robotic surgery in a hospital. Moreover we present the various stakeholders that are involved in the application of robotic systems within a hospital and their different key role, how they influence the use of such systems. The hectic aspect of economic sustainability is discussed taken into account terms of running costs, investment costs, and costs for patients and caregivers. Implementation of robotic systems is a part of a serious strategic plan of the hospital and could start composing a SWOT analysis in order to reveal Strengths, Weaknesses, Opportunities and Threats regarding Medical, Technical, Social and Ethical aspects. Specific problems such as lack of resources and coordination necessities such as restructuring and finally weaknesses in the production of services can be managed with innovative solutions such as of Robotic Surgery.

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Keywords: Healthcare services, Healthcare Administration, Robotic, Surgery

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1. Introduction

Modern hospital environment is highly connected to technology and engineering. A vast number of technological equipment is wide spread in a hospital, from laboratories to intensive care and from short-term care to operating theater. Therefore technological innovations are close related in hospital environment and the level of offered health care. Consequently technological equipment is of key importance regarding the strategic plan of the hospital on various aspects as well as the economic view. Within this paper we try to present the effect of robotic systems use in hospital environment and the effects on the strategic plan and economic aspects. Robotic surgery transforms the surgery procedure to an operation that the surgeon remotely-controlled robotic arms, which may affect the performance of procedures.

From the early 80's robotic surgery systems are used in medical procedures. Passing almost 3 decades tremendous growth has been experienced in the market of robotic surgery mainly in terms of medical equipment innovation and development. The major advantages of these systems include improved surgical outcomes, accurate procedure execution and rapid post-surgical recovery of the patient. Robotic technology has been adopted in hospitals use rapidly over the last decade both in the United States and Europe. The da Vinci Surgical System introduced in 1999 for minimally invasive surgery. Up to 31 December 2012, 2.585 da Vinci Systems have been installed in approximately 2,025 hospitals worldwide. Approximately 450,000 da Vinci procedures were performed in 2012, up approximately 25% compared to 2011(http://www.intuitivesurgical.com). Nowadays many procedures are performed robotically than laparoscopically as in the previous years. In Greece there were established 6 robotic systems and a number of more than 1000 operations have been performed (http://www.roboticsurgery.gr)

2. Experimental

Although robotic systems are quite new and not widespread, due to various reasons, it has been identified that those systems affect seriously the whole operation of the hospital. The analysis take into account the different aspects like Surgical, Economic, Organizational, Structural as well as Legal issues, Ethical issues and Patient issues that are related to the implementation of robotic surgery in a hospital. Moreover there were various stakeholders that are involved in the use of robotic systems within a hospital and their different key role.

High reliability in healthcare is founded to be the most important key aspect based on which care is delivered, called organizational culture, and that has important influences on patient satisfaction and care give [Peter J Pronovost et al, 2006). A set of strategies and factors have to be considered while introducing new robotic technologies into clinical scenario. As far as the surgical issues the important aspects are the effectiveness, patient safety. The benefits of robot-assisted surgery derive from the enhanced precision, better visualization, and easier articulation of instruments and the elimination of tremor. These parameters should allow for more precise interventions on various high difficulty and importance situations like anatomical structures such as blood vessels, nerves and other tissues can be spared. Studies directly comparing robot-assisted surgery to either laparoscopic or open surgery, however, are scarce (Ballini L, Minozzi S, Pirini G. 2008, Adams E. 2006, Ontario Ministry of Health and Long-Term Care 2004, Tooher R, Pham C. 2004).

From the economic point of view the robot-assisted surgery should be examined in terms of cost and if it is or not more expensive than the other alternatives. Aspects like equipment costs, specialized labor costs should be taken into account with their irregularities. In general there is a There is a fundamental need of cost-effectiveness analyses based on RCTs performed by experienced surgeons and including the long term impact of surgery on clinical outcomes and on health related quality of life (Camberlin C, Senn A, Leys M, Chris De Laet, 2009). Costs of robot-assisted surgery are partly dependent upon technical repairing and maintenance costs, as well as disposables costs as some specific instruments are preprogrammed to be used for only a limited number of times. The cost-effectiveness analysis is very important to see if robotic-assisted surgery is effective. Robotic surgical systems have high fixed costs, with prices ranging from $1 million to $2.5 million for each unit. Surgeons must perform 150 to 250 procedures to become adept in their use (Gabriel I. Barbash, M.D., M.P.H., and Sherry A.

Glied, 2010). In addition to that it is stated that costs of robots are high and do not justify the use of this technology considering the lack of benefits for patients (Breitenstein S, Nocito A, Puhan M, Held U, Weber M, Clavien PA., 2008).

Robotic-assisted procedures like all other informational technology systems introduce new aspects in terms of Legal, Ethical and Patient issues. The terms of consent and professional confidentiality are key principles in all medical activities from a legal point of view and technology changes the traditional way. In any case patient should be provided with clear and complete information concerning the whole proposed operation. In terms of medical liability there is no change from the traditional legal rules. From an ethical point all new and needed information should be provided to the patient in order to be able to compare with alternative procedures, to feel confident with surgical team training experience, technology efficiency and extra costs.

New technology seriously affects organizational and structural formation of any organization as well as a hospital's environment. To adopt a robotic system in the surgery life of any hospital might need making decisions about formatting the surgical robotic team, the robotics program, reviewing clinical cases, approving proctors, training staff member and surgeon (Zender J; Thell C, July 2010) rearranging the hospital's work flow and safety procedures. Surgical robots are different from other equipment such as operating blood analysis, imaging or microscopes and more over they are not traditional operating room instruments. In addition to that all operating staff should be equally and highly trained from surgeons and surgical assistant as well as all personnel. In addition to that new staff appeared in the operating room, since such high technology equipment need the presence of appropriate technical staff. In this way, emerging problems may be quickly identified and addressed (Daniel M. Herron, Michael Marohn, The SAGES-MIRA Robotic Surgery Consensus, Nov. 2007).

Implementation of robotic systems is a part of a serious strategic plan of the hospital. The strategic plan of a hospital consolidates all the above issues and is of a key importance in order to run efficiently a hospital. A very important and effective tool is SWOT analysis. This analysis reveals Strengths, Weaknesses, Opportunities and Threats regarding Economical, Medical, Technical, Social and Ethical aspects (Pickton, D. W. and Wright, S., 1998).

3. Theory

The suggested tool of SWOT analysis is presented within this part of this paper. The suggested strengths, weaknesses, opportunities and threads are the outcome of literature review (http://www.intuitivesurgical.com, Camberlin C, Senn A, Leys M, Chris De Laet, 2009) and knowledge. A SWOT analysis of adopting robotic system in hospital is presented in the following part.

Table 1. SWOT Analysis

STRENGHTS		WEAKNESSES	
1.	Lowers the risk of infection	1.	Limited sterility
2.	Lower operating procedure execution time	2.	Limited dexterity and hand-eye coordination
3.	Shorter hospital stay	3.	Long set-up time of robot and the operating room
4.	Removal of the tremor and high accuracy during surgery	4.	Social
5.	Magnification of the working field	5.	High purchase costs that make the acquisition of a group of devices really onerous
6.	Less scarring and improved cosmetics		
7.	Reduced trauma to the body	6.	Open surgery has a better costs/effectiveness ratio
8.	Reduced blood loss and need for transfusions	7.	High maintenance/ repair costs
9.	Less post-operative pain and discomfort	8.	Slow amortization
10.	Robotic system needs low space in the operating room	9.	Minimally invasive procedures are expensive because of surgeon specialization and training
11.	Simulates traditionally surgery for surgeons but provides telescopic precision Social		
12.	Speeds patient's recovery and return to normal activities		

OPPORTUNITIES	THREATS
1. Expand the application fields of robotic 2. Improve the cooperation of many research centers 3. Positively improve research though the data that collects and can be provided	1. Without a competitive plan of development of researches it could remain a niche sector too high costs too less application fields open surgery or laparoscopic techniques would be predominant 2. Finite number of hospitals potential users aimed towards larger hospitals 4. Requires doctors to be trained extensively 5. Liability from accidents/malfunctions of robots

The financial effects of robotic surgery application are examined within this paper comparing data from a medium size urban hospital in Athens for 2012 and already published data from United States of America (Center for Evidence-based Policy Oregon Health & Science University, 2012). In the table 2 below the discharges for three operations groups are presented with the corresponding hospitalization days of the medium size hospital. The reimbursement in Greek health system is based on fix costs of operations (Greek DRGs). In table 2 we present the fix cost price that the hospital receives as well as the days that are officially paid. We selected three operation groups among seventy five groups in order to prove the reduction in hospitalization only costs that might have a medium size urban hospital by implementing robotic surgery.

Table 2. Operations, number of Discharges and hospitalization days vs price reimbursement and days

			Fix Reimbursement Greek DRGs	
Operations groups	Discharges	Days	Days paid	Price
Operations perianal and dermoid disease (bladder fistula, abscess, etc.)	29	109	2	626 €
Operations hernia (inguinal, umbilical hernia, etc.) without coexisting disease - complications	26	105	2	868 €
Nasal Operations	25	71	2	600 €

Table 3 presents the total amount of money reimbursement for a medium size hospital for the cases described in table 2 as well as the extra days of hospitalization revealing inefficiency due to traditional surgery methods that the hospital engage. After the elaboration of data provided by Center for Evidence-based Policy Oregon Health & Science University, year 2012 in table 3 we estimate based on a mean of 27% of reduction in hospitalization days using robotic surgery. Implementing robotic surgery a hospital can save about 5% only from the hospitalization costs. In last column is presented the reduction of total costs that a hospital can save in case of robotic surgery use. This cost reduction only results from less of hospitalization days.

Table 3. Operations, total costs, number of Discharges and hospitalization days vs price reimbursement and days

Operations groups	Hospital's reimbursement for all cases per operation group	Extra days of hospitalization	27% days of hospitalization	Cost save for days (hospitalizations cost 80€)
Operations perianal and dermoid disease (bladder fistula, abscess, etc.)	18.154 €	51 (188%)	-14	1.120 €
Operations hernia (inguinal, umbilical hernia, etc.) without coexisting disease – complications	22.568 €	53 (198%)	-14	1.120 €
Nasal Operations	15.000 €	21 (142%)	-6	480 €
	55.722 €			2.720 €

4. Results and Discussion

The aspects of the SWOT analysis that affect the cost of robotic surgery implementation are numerous. Some them are lower operating procedure execution time, shorter hospital stay, less post-operative pain and discomfort, robotic system needs low space in the operating room, speeds patient's recovery and return to normal daily activities, high purchase costs that make the acquisition of a group of devices really onerous, high maintenance/ repair costs, requires doctors to be trained extensively. All those aspects, except the initial installation fix cost ranging from $1 million to $2.5 million for each unit (Gabriel I. Barbash, M.D., M.P.H., and Sherry A. Glied, 2010) and the high cost of service and consumables, can reduce the cost and discomfort in contrast to open operation procedures.

As far as the costs that presented in table 2 we can conclude that in case of robotic operation implementation in such a medium size urban hospital for only 3 common operations we have a reduction in hospitalization days of approximately 5% or in economic word a cost reduction of 2.720€. The calculation is based on the reduced fix fee of 80€. This save is only gained from the hospitalization costs. In order to have a precise number of money save, based on the results of SWOT analysis, we have to take into account some indirect costs that can be saved, like drugs, extra cost for doctors and other paramedical personnel, the availability of beds and operation theaters for more operations, labor costs due to immediate return in work of the patient.

5. Conclusions

The main conclusions of the study are that although for some cases robotic surgery proved not to be cost effective, in total and taking into account all aspects that are involved in a hospital, robotic surgery is worth implementing. A further study should be done with data of big hospitals and more operations. The data used for the example of the study was in raw format and not enough qualitative. This paper aims to provide a foundation for further and more detailed studies that will include also other hospital functional parameters such consumables, medicines, indirect costs etc. Those parameters will have a direct relationship with both the economic view of the hospital as well as with patient's satisfaction and quality of life. The compensation of hospitals and health service providers highly affects Greek health care. In addition to that indirectly affects in exaggerated degree social security system of the country. As a result those studies will be of great interest on the part of the Social Funding.

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